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ABSTRACT

This workbook is part five of a self-instructional course prepared for the United States Environmental Protection Agency. The student proceeds at his own pace and when questions are asked, after answering, he either turns to the next page to check his response or refers to the previously covered material. The purpose of this course is to prepare the student for the APC Training Certificate. This section introduces the student to the incinerator, its basic parts, and the fundamentals of incineration. (BT)

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# Air Pollution Training Institute Self-Instructional Course SI-466

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# Part 5
# The Incinerator: Section One
# Basic Parts and Fundamentals

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SE 015 641

United States
Environmental Protection Agency
Office of Air and Water Programs

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# Training Manual
# Self-Instructional Course SI-466

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## Air Pollution Training Institute

United States
Environmental Protection Agency
Contract No. 68-02-0321
David Sage, Inc.
New York City, New York

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# Part Five:
# The Incinerator:
# Section One
# Basic Parts and Fundamentals

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Prepared for the
United States Environmental Protection Agency
Office of Air and Water Programs
Control Programs Development Division
Air Pollution Training Institute

US EPA

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CONTROL PROGRAMS DEVELOPMENT DIVISION
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Francis J. King
Chief, Air Pollution Training Institute

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# 5

THIS IS PART
THE INCINERATOR: SECTION ONE
BASIC PARTS AND FUNDAMENTALS

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Additional units of this self-instructional course are:

PART ONE
The Basics of Preventing Air
Pollution Emissions from Boilers

PART TWO
The Basics of Boiler Operation
and Maintenance

PART THREE
Troubleshooting, Section One
Boilers: Correcting Oil Temperature

PART FOUR
Troubleshooting, Section Two
Boilers: Flame Reading

PART SIX
The Incinerator: Section Two
Maintenance and Troubleshooting

SUPPLEMENT A:
Operator's Manual, Boiler Room
Operations and Maintenance

# INCINERATOR, PART 1: INTRODUCTION

In the past, incinerators have belched out smoke and fly ash. To combat this health and property hazard, New York City has passed upgrading laws. These include:

I. INCINERATORS UPGRADED – INCLUDING SCRUBBERS
II. OPERATORS TRAINED IN RUNNING UPGRADED EQUIPMENT

Some smoke and fly ash are unavoidable. Keep emissions at a minimum by keeping your INCINERATOR CLEAN and in GOOD CONDITION.

CHECK ( √ ) what you can do to keep down incinerator pollution:

____1. Take this course in proper incinerator operation.

____2. Keep the incinerator clean and in good condition.

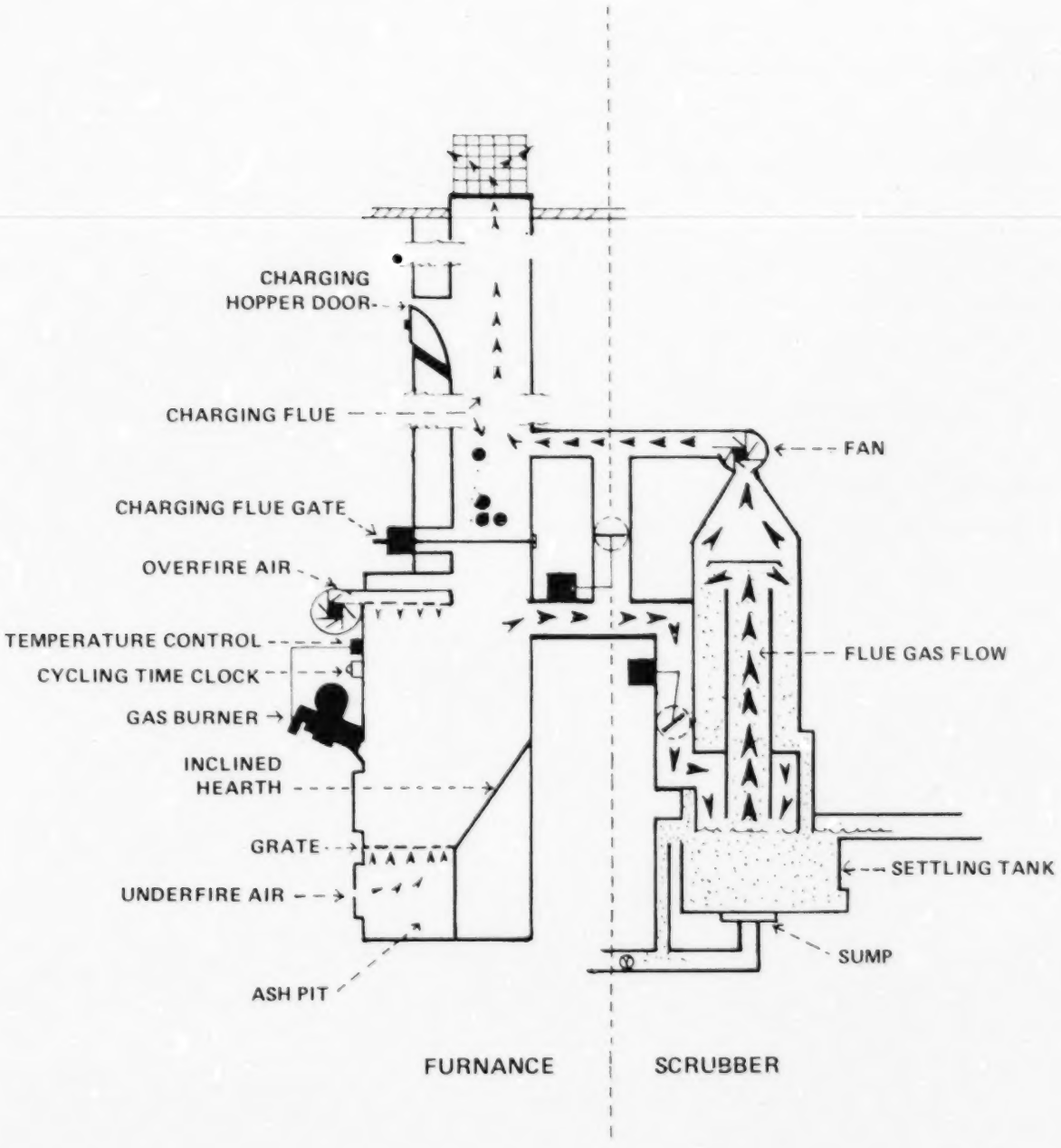
– Check your answer.

___ 1.

___ 2.

## INCINERATOR PARTS

HERE ARE SOME BASIC INCINERATOR PARTS. LOOK THEM OVER.



Answer these questions using the opposite diagram:

1. As the garbage is put through the hopper door and falls down the charging flue, what device holds it until firing time? _____

2. Name the two air supplies to the incinerator. _____

3. What timing device controls the incinerator? _____

4. How hot the fire is, is regulated by what control? _____

5. What kind of a burner provides the required incinerator temperature? _____

6. What major part cleans the incinerator gases by circulating them through water? _____

7. What is at the bottom of the scrubber which lets you drain or clean the settling tank? _____

– Check your answers.

1. Charging flue gate
2. Overfire air
   Underfire air
3. Cycling time clock
4. Temperature Control
5. Gas Burner
6. Scrubber
7. Scrubber sump

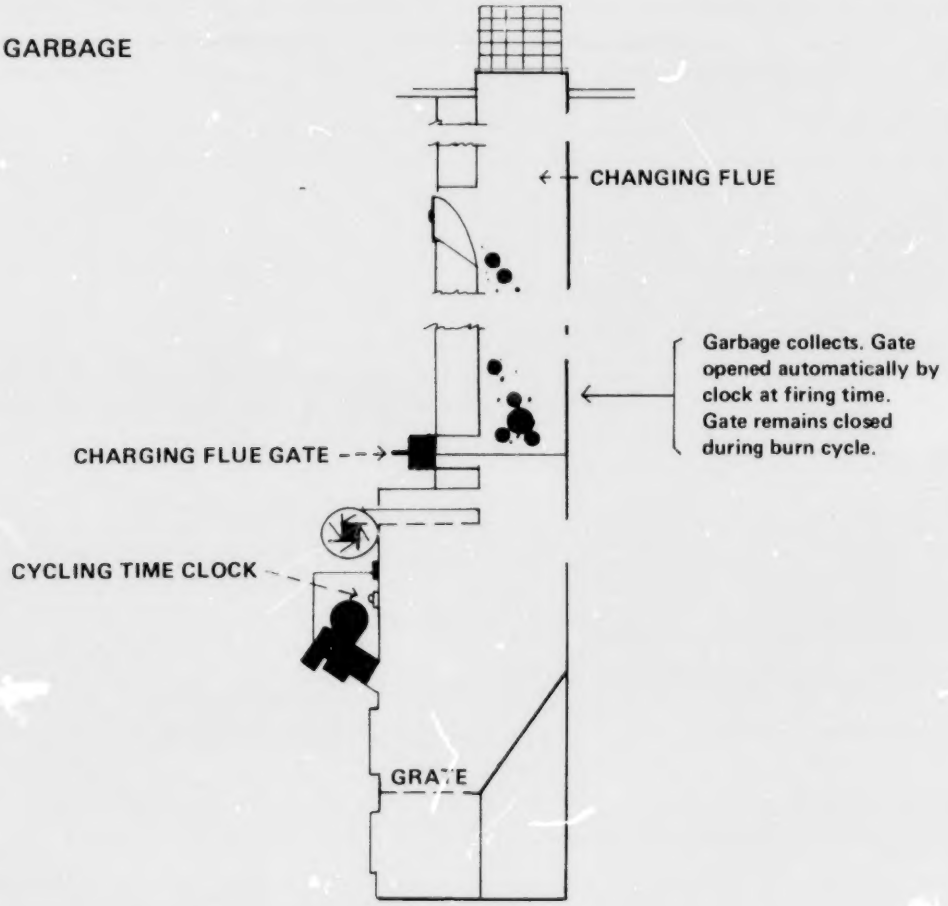
# BURNING

A burn needs three things:

1. GARBAGE
2. AIR
3. IGNITION AND HEAT - the burner

Good combustion needs a FAST, HOT FIRE. For this to happen the garbage, air, draft, and burner must be controlled. The CYCLING TIME CLOCK is set and at the proper time these three are automatically brought together for burning.

FIRST – GARBAGE


CHANGING FLUE
Garbage collects. Gate opened automatically by clock at firing time. Gate remains closed during burn cycle.
CHARGING FLUE GATE
CYCLING TIME CLOCK
GRATE

MAKE THE FOLLOWING MARKS ON THE DIAGRAM:

– WRITE "HOPPER" where the tenants deposit their garbage.

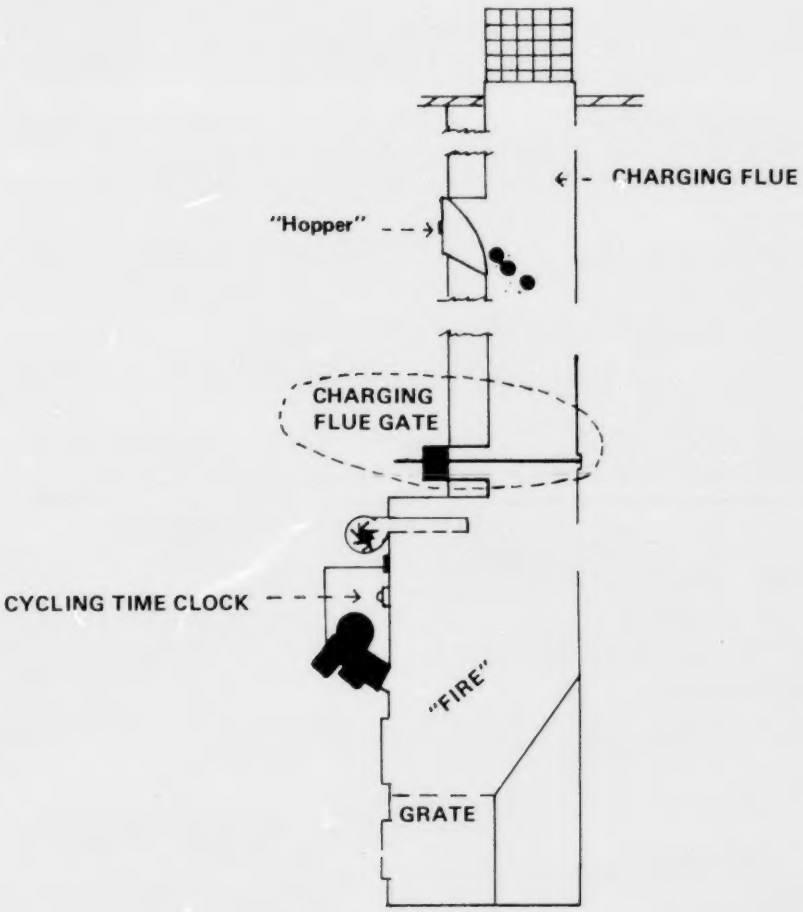
– PUT A CIRCLE around the part that holds the garbage until firing time.

– UNDERLINE THE NAME of the part that controls the movement of the gate to drop the garbage onto the hearth.

– WRITE "FIRE" in the chamber where the fire takes place.

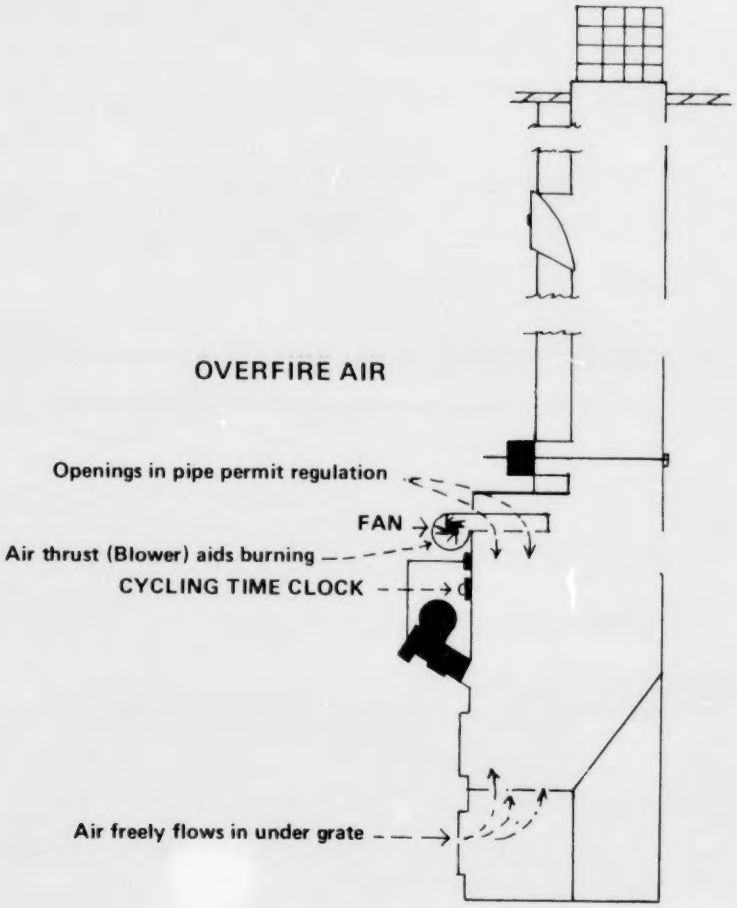
– Check your answers.

ANSWERS TO PREVIOUS PAGE:



NEXT – AIR – OVERFIRE AND UNDERFIRE

Study this diagram and answer the questions on the opposite page.



Remember that the CYCLING TIME CLOCK regulates all major equipment.

1. Which is turned on and off by the time clock, or Underfire Air? _____

2. Which is produced by a fan and blown into the incinerator, Overfire Air or Underfire Air? _____

3. Which air to the incinerator is not turned on by the time clock, but is free flowing? _____

4. What device starts the fan for Overfire Air? _____

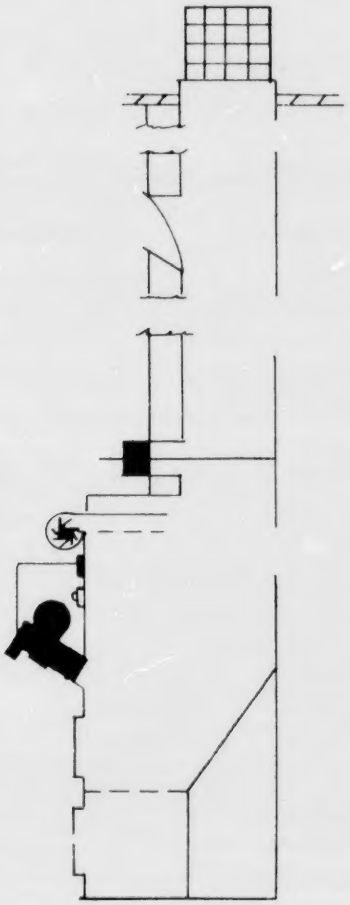
— Check your answers.

1. Overfire Air
2. Overfire Air
3. Underfire Air
4. Cycling Time Clock

---

This is how GARBAGE and AIR get into the incinerator. LABEL THE FOLLOWING ON THE DIAGRAM:

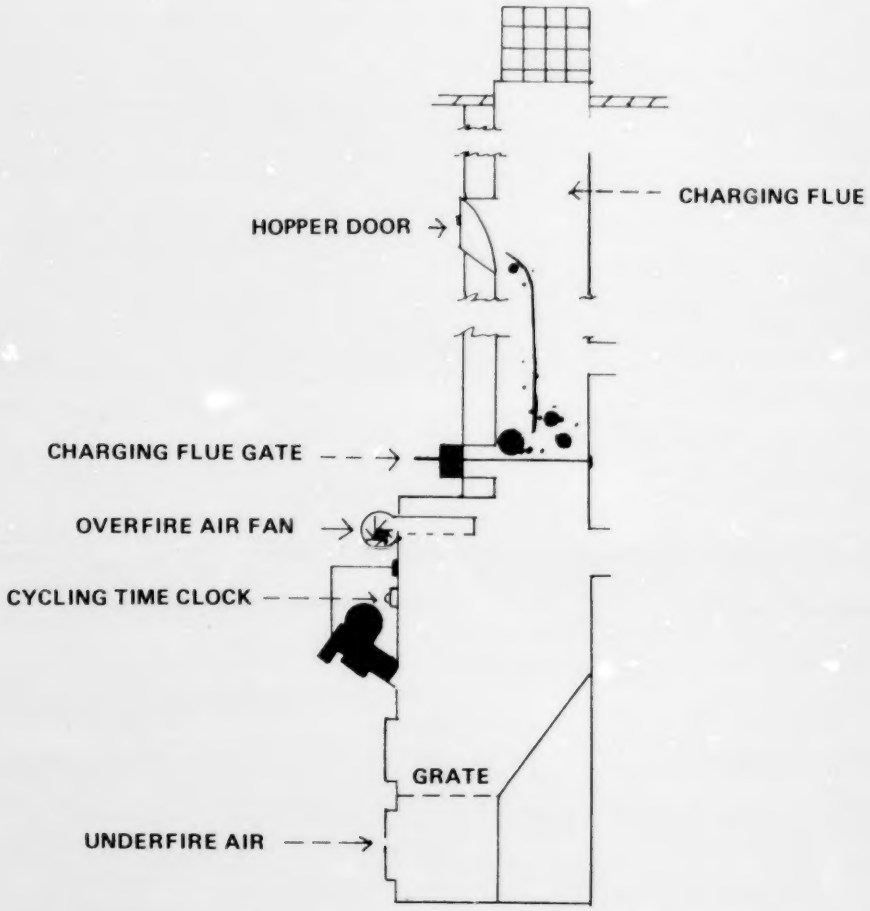
1. Hopper Door
2. Charging Flue
3. Charging Flue Gate
4. Grate
5. Cycling Time Clock
6. Overfire Air (and Fan)
7. Underfire Air
8. Draw a line showing the path of the garbage.



For good combustion, be sure there is a good basic air supply to the incinerator room.

– Check and correct your answers.

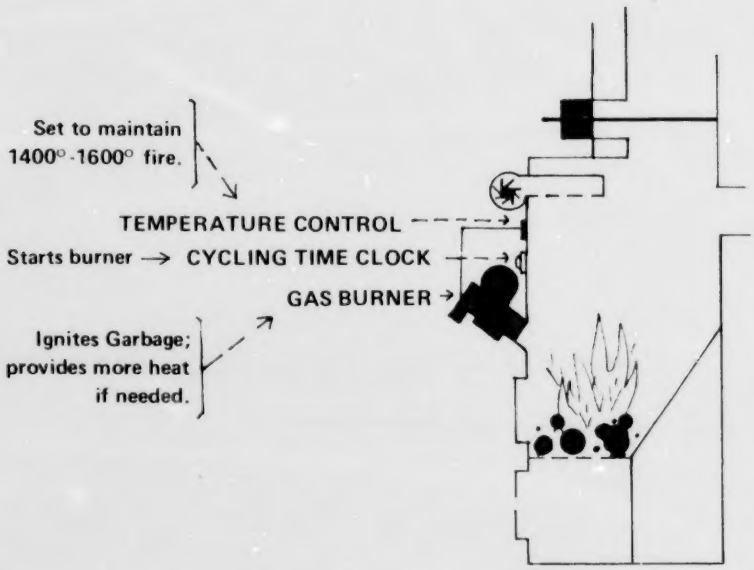
ANSWERS TO PREVIOUS PAGE.




NOW – IGNITION (THE BURNER)

## IGNITION AND HEAT – THE BURNER

For a hot, fast burn the three parts below must be working properly.




### ANSWER THESE QUESTIONS:

1. What starts the burner at firing time? _____

2. What ignites the garbage (starts the fire)? _____

3. What instrument monitors the fire temperature? _____

– Check your answers.

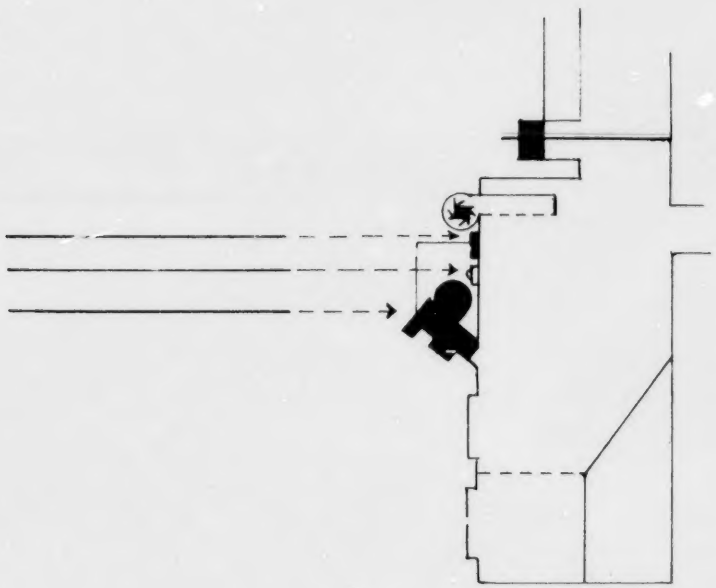
1. Cycling Time Clock
2. Gas Burner
3. Temperature Control

---

The burning chamber is closed off when the Charging Flue Gate closes. It closes after dropping garbage to the grate. It stays closed during the burn and collects garbage for the next burn.

PUT THE NAMES OF THESE PARTS ON THE DIAGRAM:

1. This starts the burner (also controls garbage and air)
2. This ignites the garbage
3. This keeps the fire between 1400F - 1600 F.



Check and correct your diagram on the previous page.

CIRCLE THE CORRECT WORDS:

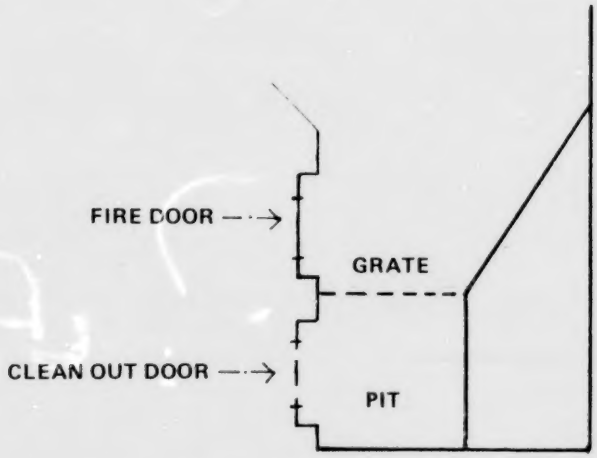
A good incinerator burn is HOT/WARM and SLOW/FAST.

– Check your answer.

# AFTER THE BURN

You are probably no longer surprised at the junk that ends up in your incinerator.

Here is the area to clean after the burn, when the incinerator is COOL.




1. Where will cans and bottles be left after the burn? _____

2. Where will the ashes fall during and after the burn? _____

3. Through what door would you clean the grate? _____

4. Through what door would you remove ash that had fallen through the grate? _____

– Check your answers.

1. On the grate
2. Pit under Grate
3. Fire Door
4. Clean out door

---

## BURNING REVIEW

1. What three things are needed for a burn? _____ _____ _____

2. What device controls these three to start the burn? _____

3. What part holds the garbage, then opens to allow it to fall into the burning chamber? _____

4. Name the two air sources to the fire chamber. _____ _____

5. What piece of equipment ignites the garbage? _____

6. What device monitors the burn for correct temperature? _____

7. What two places need to be cleaned after the fire is out? _____ _____

— Check your answers.

ANSWERS TO PREVIOUS PAGE:

1. Gargage
   Air
   Ignition (Burner)

2. Cycling Time Clock

3. Charging Flue Gate

4. Overfire Air
   Underfire Air

5. Gas Burner

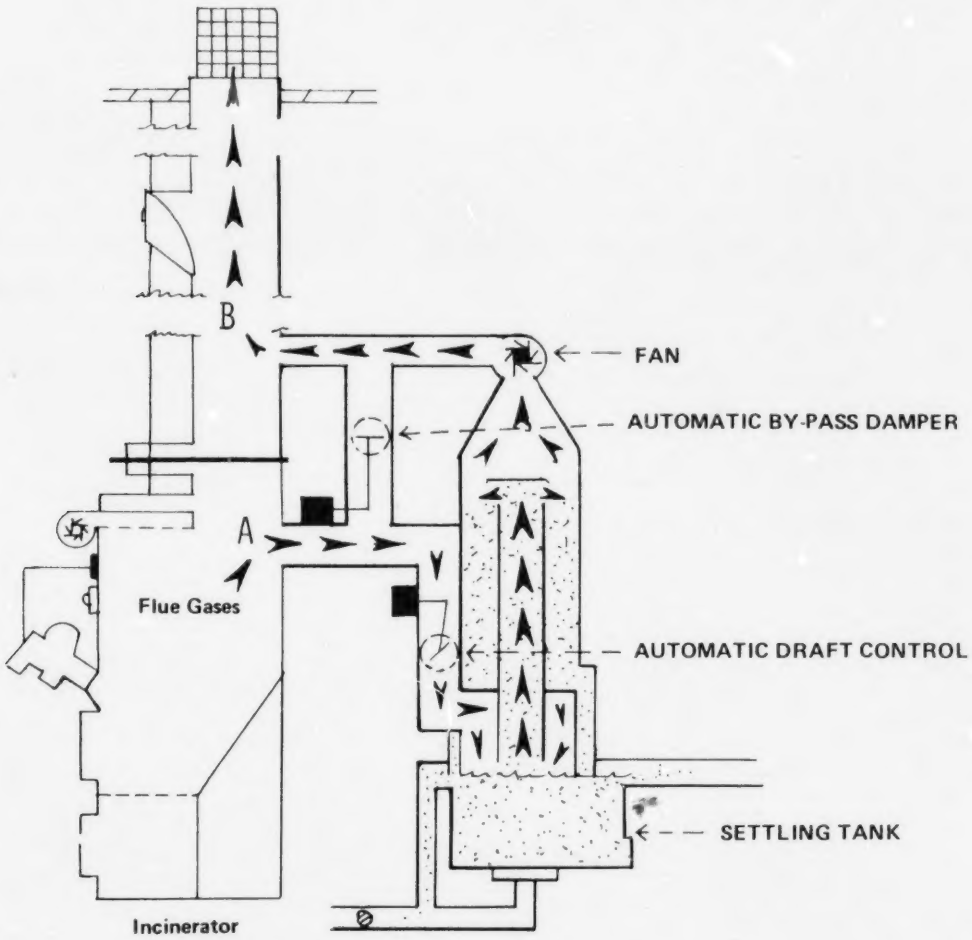
6. Temperature Control

7. Grate
   Ash pit under Grate

# SCRUBBING THE GASES

New York City upgrading standards require all incinerators to have a SCRUBBER. As the garbage is burned the EXHAUST GASES ARE CLEANED BY BEING WASHED VIGOROUSLY WITH WATER before going out the Stack.

Here is a basic Scrubber diagram.



Answer these questions as to how the Scrubber works:

_____ 1. Gases from the burning chamber are pulled into the Scrubber by:

A. a pump
B. overfire air supply
C. fan induced draft

_____ 2. The dotted area on the diagram represents:
A. Quiet water to let the fly ash settle.
B. Churning water to wash the fly ash from the gases.

_____ 3. Are gases cleaner at Point A on the opposite diagram or Point B?

– Check your answers.

B 1.
B 2.
B 3.

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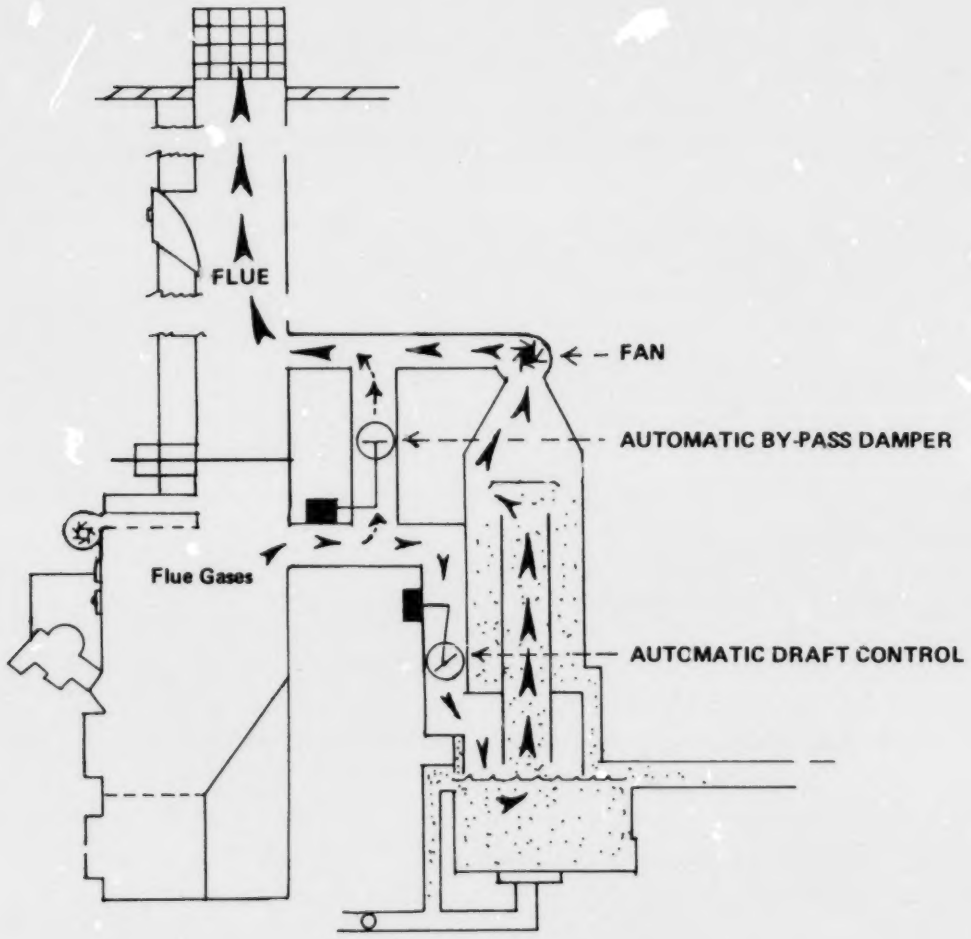



Gases are moved by a FAN and controlled by a DAMPER and DRAFT CONTROL. Normally the AUTOMATIC DRAFT CONTROL directs gases into the scrubber. When the scrubber is temporarily shut down for cleaning or maintenance or an emergency such as water failure, the AUTOMATIC BY-PASS DAMPER is adjusted so that gases are directed past the scrubber and up the stack without being cleaned.

MATCH the devices with what they do:

____ Automatic By-Pass Damper
____ Automatic Draft Control
____ Fan

A. Pulls gases from the Scrubber water and out the flue.
B. Directs gases from the burn on out the flue without going through the Scrubber.
C. Directs gases from the burn into the Scrubber.

– Check your answers.

B Automatic By-Pass Damper

C Automatic Draft Control

A Fan

---

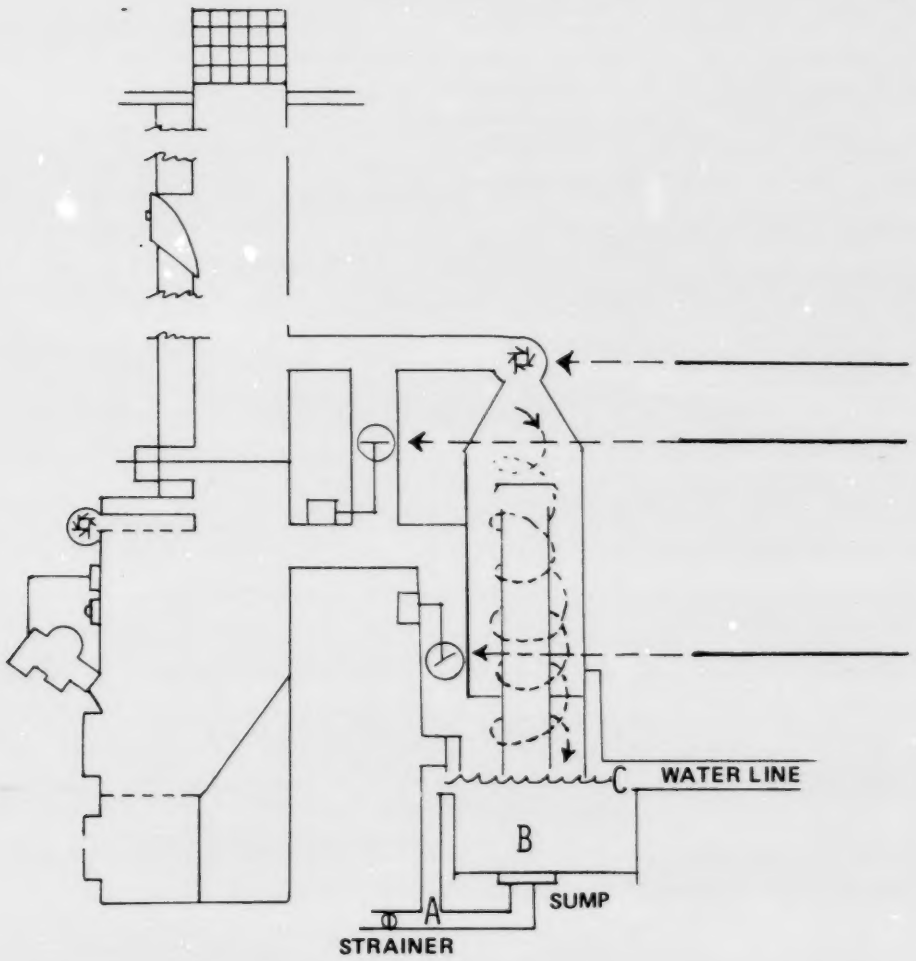
On the diagram, LABEL THESE PARTS:

AUTOMATIC BY-PASS DAMPER

AUTOMATIC DRAFT CONTROL

FAN

DRAW A LINE SHOWING THE PATH OF FLUE GASES



Check your diagram with the one of the previous page and CORRECT IT if necessary.

The water in the Scrubber is churning vigorously – DIRT and ASH SETTLE in the TANK at the bottom.

Answer these questions with one of the LETTERS FROM THE DIAGRAM:

_____ 1. At what point does water enter the scrubber?

_____ 2. At what point does water leave the scrubber?

_____ 3. What letter indicates the Settling Tank where dirt will collect?

– Check your answers.

C 1.
A 2.
B 3.

# ASH CATCHERS

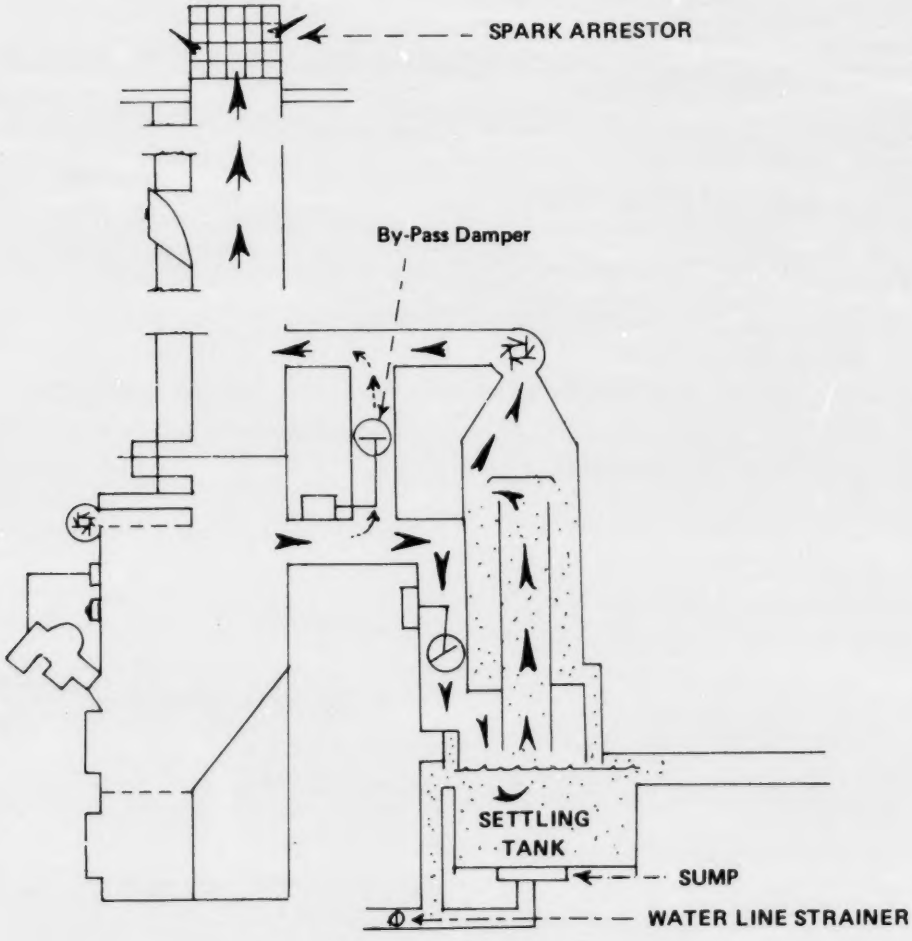
ASH in the scrubber will either

1. SETTLE in the tank, or be
2. CARRIED OUT THE WATER LINE with the water.

Little ash will go up the stack.

When the BY-PASS DAMPER is OPEN all the ash floats freely up the stack. The gases do not go through the scrubber.

SEE THREE ASH CATCHERS BELOW:



Answer these questions with a part from the diagram:

1. Where do you clean out the settling tank? _____

2. What filters ash from the water as it leaves the tank? _____

3. What is the only device which will stop large burning material when the by-pass damper is open? _____

– Check your answers

1. Scrubber Sump
2. Water Line Strainer
3. Spark Arrestor

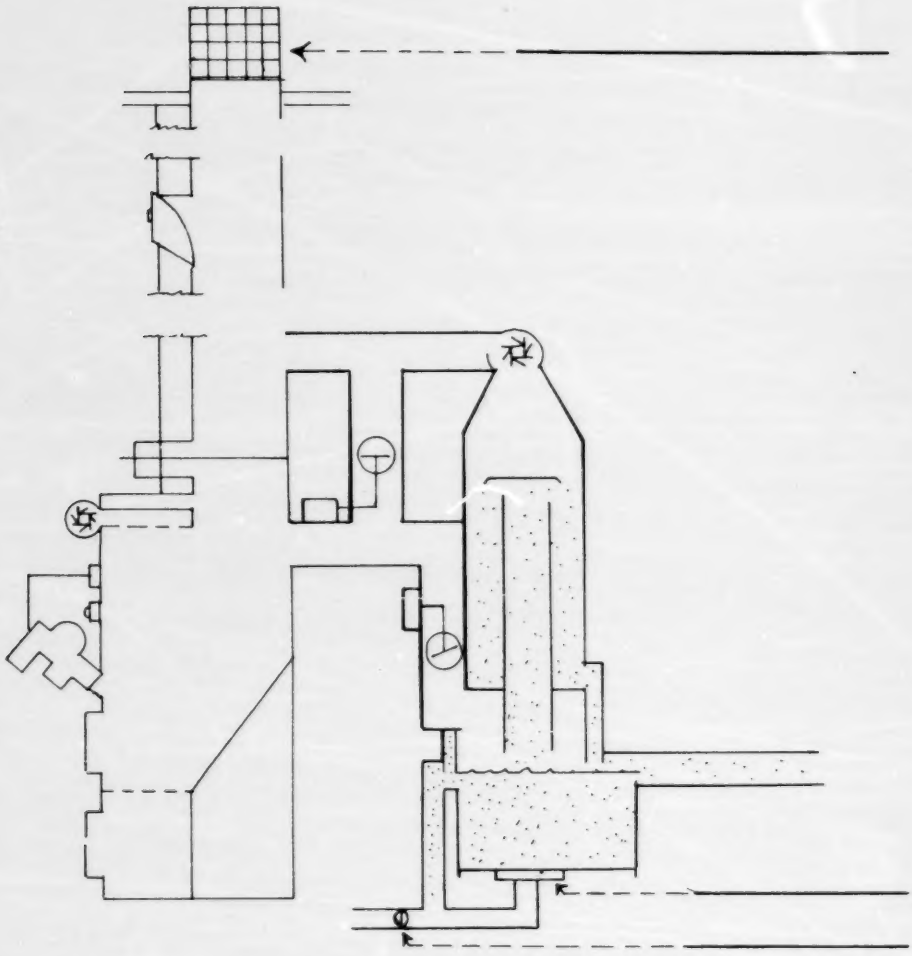
---

On the diagram below, LABEL THE ASH CATCHERS:

SUMP

WATER LINE STRAINER

SPARK ARRESTOR



CHECK YOUR ANSWERS ON THE PREVIOUS PAGE.

Which of these can you clean? _____

— Check your answer.

all of them

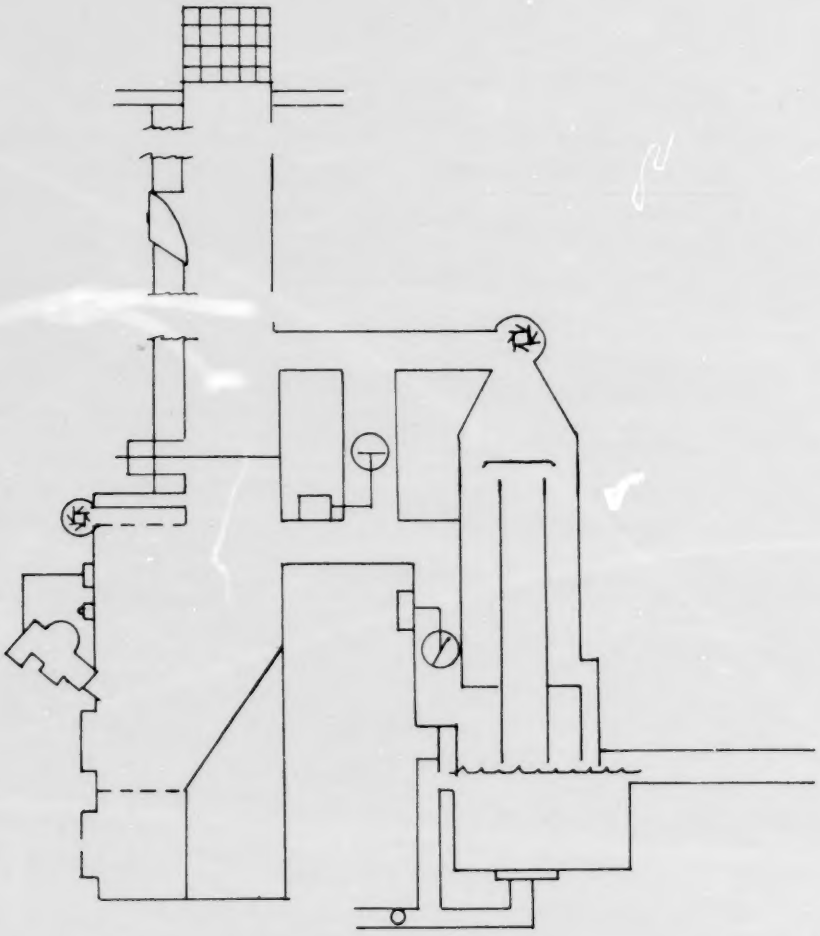
# SCRUBBER REVIEW

Below is an outline of an Incinerator-Scrubber. In it LABEL OR MARK THE FOLLOWING:

Automatic By-Pass Damper
Automatic Draft Control
Scrubber Settling Tank
Fan
Sump
Water Line Strainer
Spark Arrestor

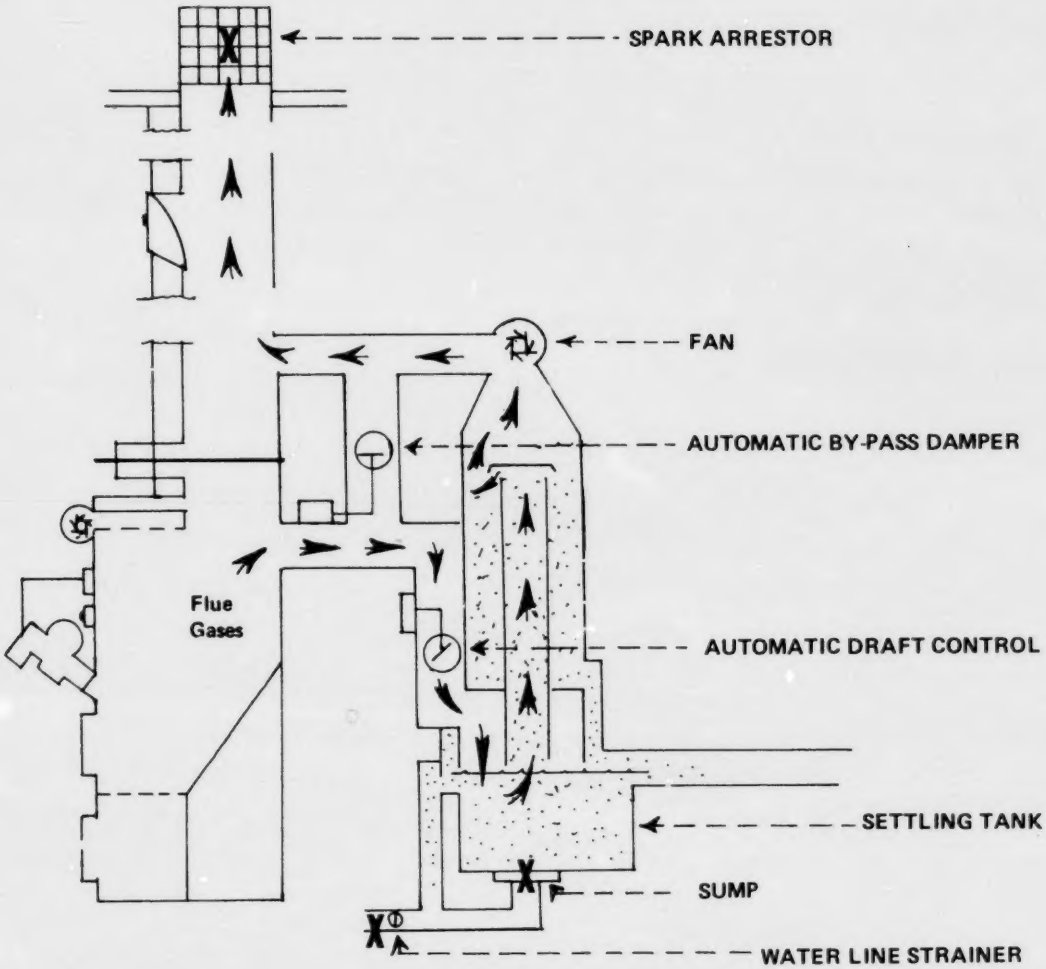
DRAW ARROWS showing the path of the flue gases.

PUT "X" on three ASH CATCHERS.



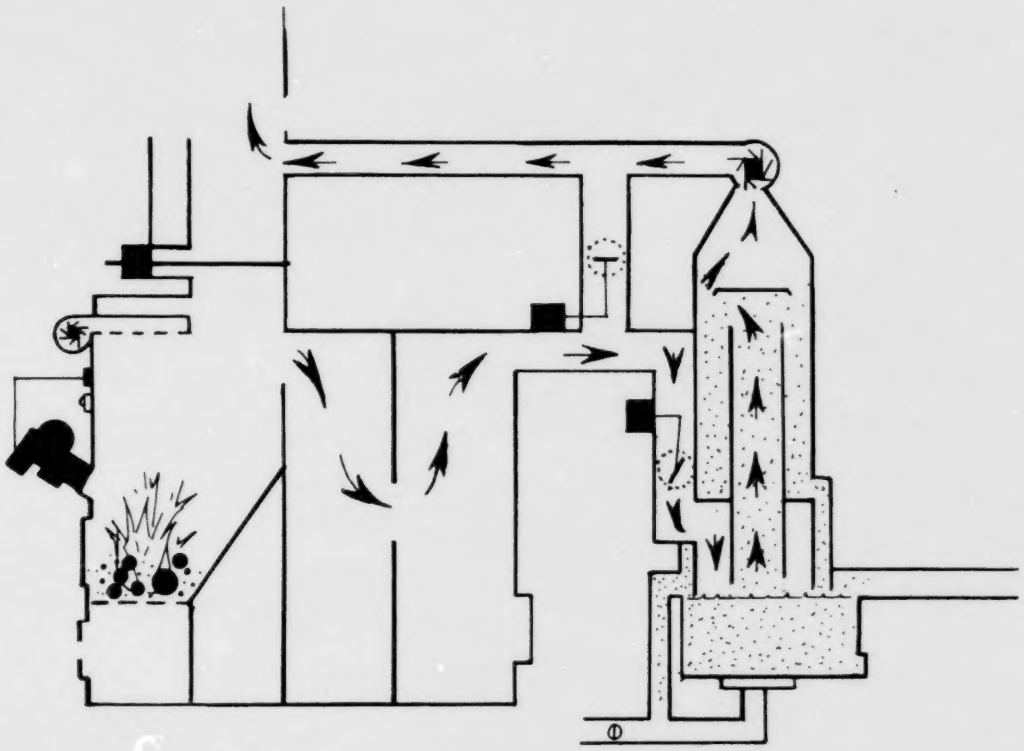
– Check and correct your answers.

ANSWERS TO PREVIOUS PAGE:



# MULTI-CHAMBER INCINERATORS

In many systems, gases pass through one or more SEPARATION CHAMBERS AFTER THE BURN. Large residue falls here before gases go into the scrubber.



WRITE "S" IN THE SEPARATION CHAMBERS ABOVE.
WRITE "X" WHERE large waste will fall.

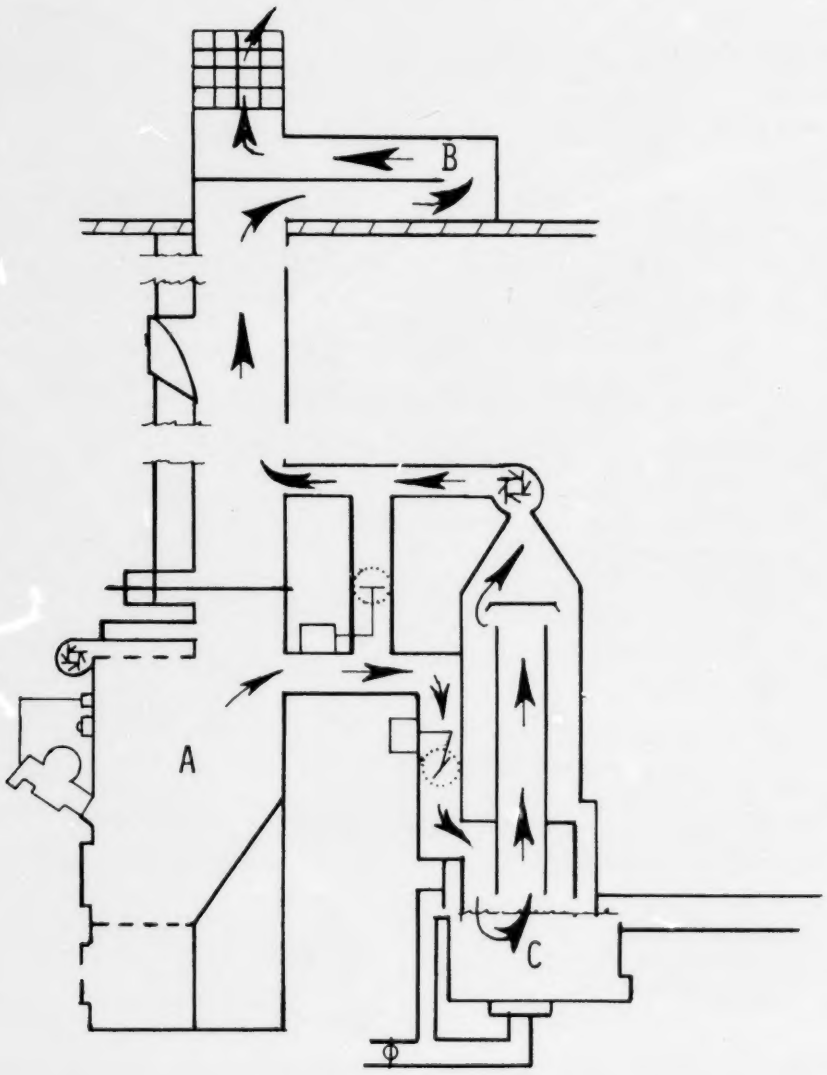
There are two Separation Chambers above. There may be as many as four. The floors should be cleaned regularly.

Does your system have Separations Chambers? _____

If so, how many? _____

# GETTING CAUGHT ON THE ROOF

Some systems have a ROOF SETTLING CHAMBER. ASH settles here before gases go out into the air.




CIRCLE THE CORRECT WORDS:

The roof settling chamber is A/B/C above.

It is useful when the scrubber IS/IS NOT operating

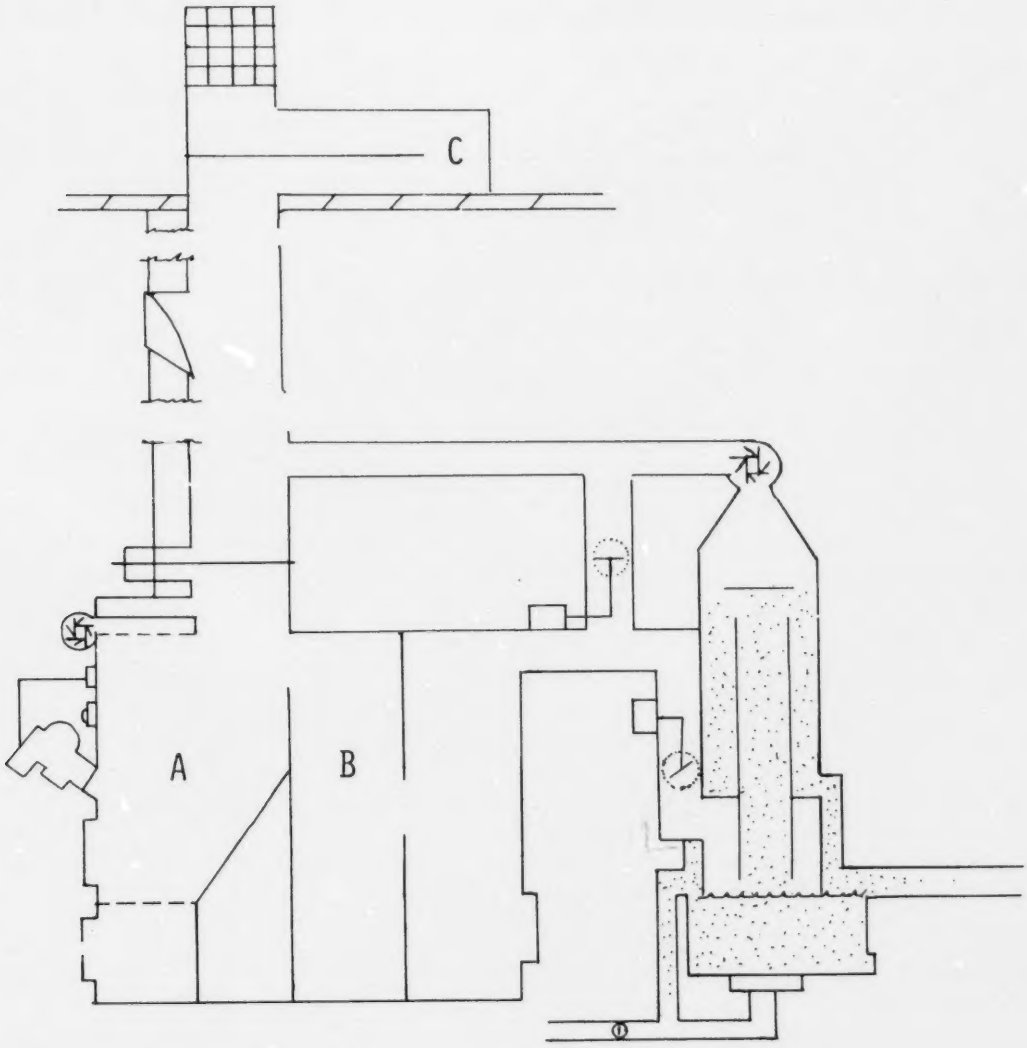
The roof settling chamber is on the roof - B opposite. If the by-pass damper is open (scrubber not in use), the roof chamber will collect most large ash.

Do you have a Roof Settling Chamber? _____

If so, do you clean it regularly? _____

— Go on to the next page.

# MULTIPLE CHAMBER REVIEW




**Name the chambers indicated by the letters above:**

A _____

B _____

C _____

1. Are the materials collected in B and C mostly fine ash or relatively large particles? _____

2. Which chamber cleans gases before the scrubber? _____

3. Which cleaning chamber is important when the scrubber is not in use? _____

— Check your answers.

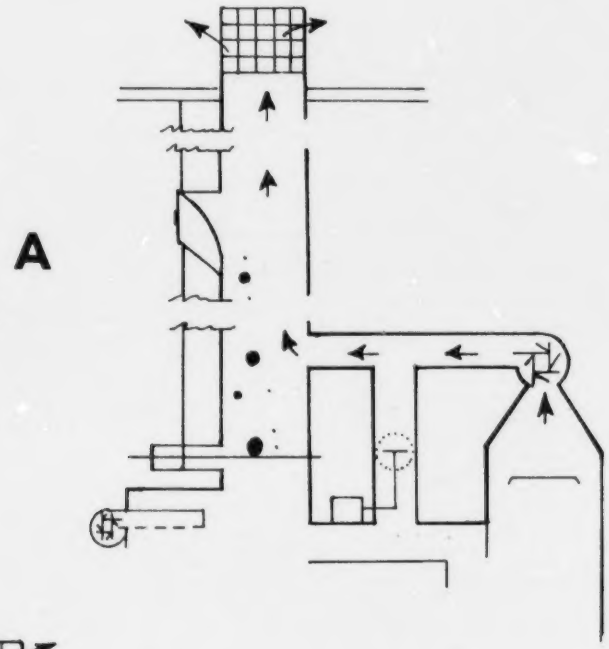
A. Burning Chamber
B. Separation Chamber
C. Roof Settling Chamber

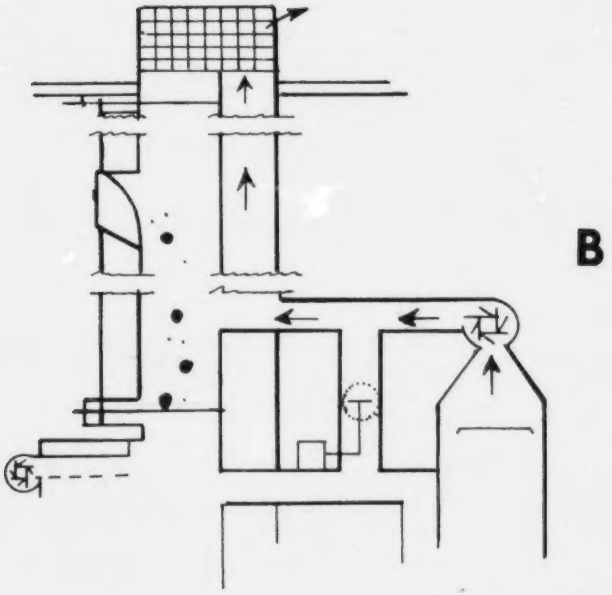
1. large particles
2. B - Separation Chamber
3. C - Roof Settling Chamber

## TWO FLUES ARE BETTER THAN ONE

Some incinerators have DOUBLE FLUES. So far only single flues have been shown.

LOOK AT THESE DIAGRAMS.

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ANSWER THESE QUESTIONS WITH "A" or "B."

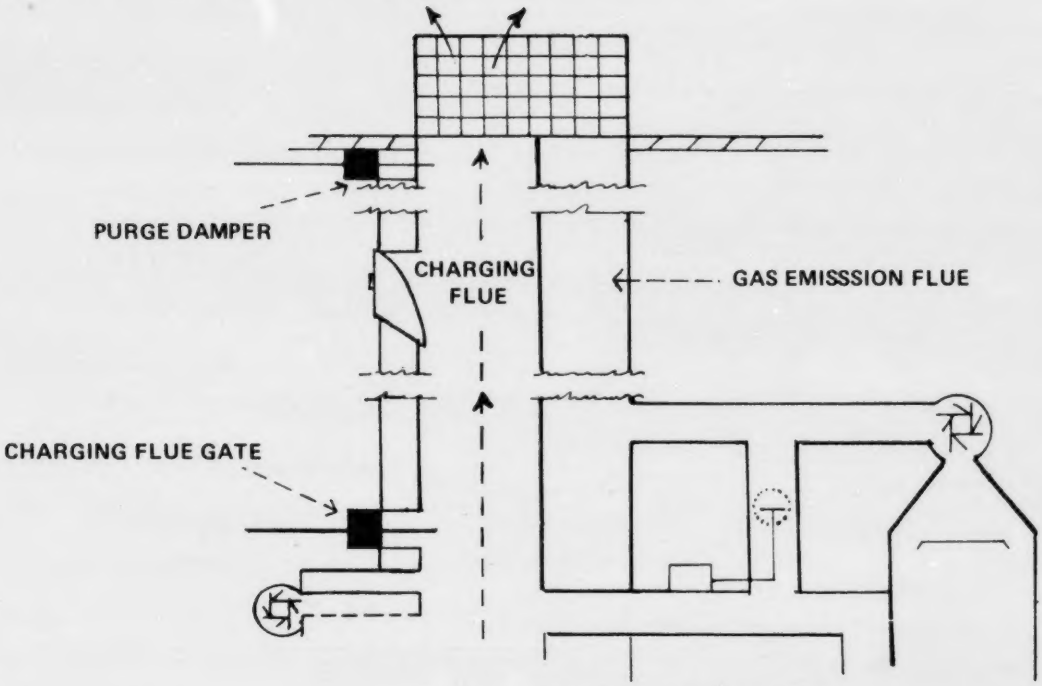
___ 1. Which is a single flue?
___ 2. Which is a double flue?
___ 3. Which uses the same flue for garbage going down and gases going up?
___ 4. Which uses separate flues for garbage and gases?

Separate flues are a big advantage. Tenants can put garbage in the hopper any time without the danger of hot gases and flying ash.

Separate flues are shown in B and questions 2 and 4 above.

Single flue hoppers should automatically lock during burning. This is very important for safety and should be checked regularly.

Do you have a Single or Double flue incinerator? _____




DOUBLE FLUE INCINERATOR

A PURGE DAMPER allows periodic cleaning of the Charging Flue. Garbage, grease and insects are burned off by automatic sequence of the steps below:

TURN GAS BURNER ON
OPEN PURGE DAMPER
OPEN CHARGING FLUE GATE
SHUT DOWN SCRUBBER

Hot gases then go straight up the Charging Flue and clean it. Dotted line above show the path of these gases.

1. Waste gases normally go up which flue? _____

2. When cleaning the charging flue, hot gases are directed up which flue? _____

3. A purge damer is needed in double flue incinerators because:

   A. It controls the draft.
   B. It is needed to burn out the charging flue. _____

— Check your answers.

1. Gas Emission Flue
2. Charging Flue
3. B

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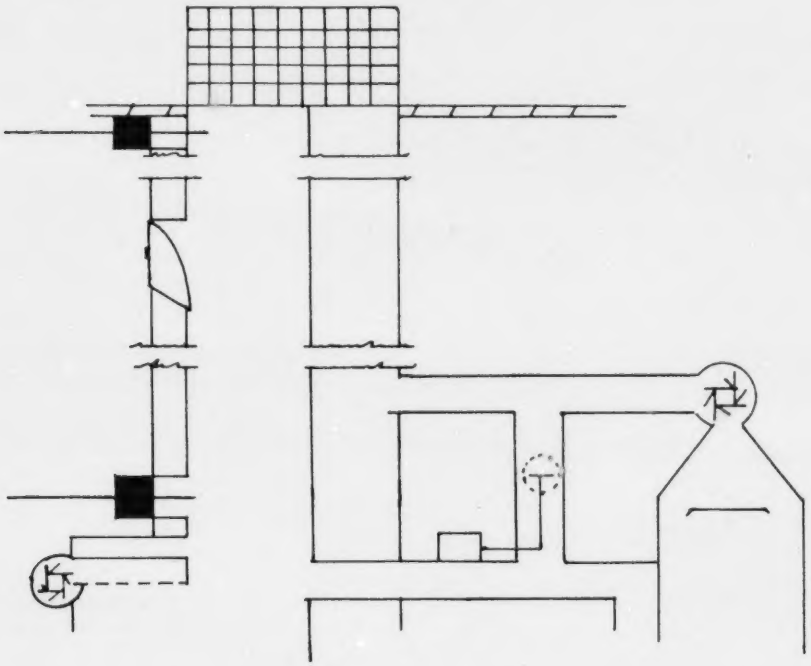
# DOUBLE FLUE REVIEW



On the diagram –

LABEL the CHARGING FLUE
LABEL the GAS EMISSION FLUE
LABEL the PURGE DAMPER
DRAW A LINE showing the path of hot purge gases.
DRAW ARROWS showing the normal path of gases from the scrubbers.

CHECK YOUR DIAGRAM ON THE PREVIOUS PAGE, correct it if necessary.

# HANDBOOK WRAP-UP

This completes the introduction to basic incinerator parts. Your system may not exactly match the diagrams shown but it should be similar.

TURN TO YOUR INCINCERATOR HANDBOOK.

PAGE 2 - 3: Basic parts and definitions are included here for your future reference.

PAGE 5: Here is a general incinerator outline. On it LABEL THINGS ABOUT YOUR INCINERATOR THAT ARE DIFFERENT FROM THE EXAMPLE IN THIS LESSON. (You may have a different type of Scrubber).

PAGE 7: RECORD THE STATISTICS OF YOUR SYSTEM HERE.

# SUMMARY OF PART V

These questions review the important things in this section:

1. Is a good incinerator fire hot and fast or moderate and slow? _____

2. What three basic ingredients are needed for an incinerator fire? _____

_____

_____

3. What device is set to coordinate the burn (drop the garbage, start the overfire air, start the burner)? _____

4. What part of the incinerator actually holds the garbage above the furnace until firing time? _____

5. Name the two direct air supplies to the fire? _____

_____

6. Which can be regulated, Overfire Air or Underfire Air? _____

7. What two places under the furnace collect waste bottles, cans and ash? _____

8. What major device should all incinerators have to clean flue gases? _____

9. What circulates in the scrubber to clean the flue gases? _____

10. Are flue gases pulled from the furnace into the scrubber by the automatic draft control or by-pass damper? _____

11. Are the flue gases directed out the flue without going through the scrubber by the automatic draft control or by-pass damper? _____

12. What is at the bottom of the settling tank which collects dirt and must be cleaned regularly? _____

13. What device should be in the water line leaving the scrubber to collect ash in the water? _____

14. What device pulls gases from the scrubber and out the flue? _____

15. What are separation chambers used for? _____

16. A double flue incinerator is one that permits you to switch garbage collection from one to the other. (TRUE or FALSE) _____

ANSWERS TO REVIEW QUESTIONS:

1. hot and fast
2. garbage
   air
   ignition (burner)
3. cycling time clock
4. charging flue gate
5. overfire air (blower)
   underfire air
6. overfire air
7. grate
   ash pit
8. scrubber
9. water
10. draft control
11. by-pass damper
12. sump
13. strainer
14. fan
15. cleaning the gases, collecting ash
16. False